

## Video Article

# The use of Biofeedback in Clinical Virtual Reality: The INTREPID Project

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## Abstract

Generalized anxiety disorder (GAD) is a psychiatric disorder characterized by a constant and unspecific anxiety that interferes with daily-life activities. Its high prevalence in general population and the severe limitations it causes, point out the necessity to find new efficient strategies to treat it. Together with the cognitive-behavioral treatments, relaxation represents a useful approach for the treatment of GAD, but it has the limitation that it is hard to be learned. The INTREPID project is aimed to implement a new instrument to treat anxiety-related disorders and to test its clinical efficacy in reducing anxiety-related symptoms. The innovation of this approach is the combination of virtual reality and biofeedback, so that the first one is directly modified by the output of the second one. In this way, the patient is made aware of his or her reactions through the modification of some features of the VR environment in real time. Using mental exercises the patient learns to control these physiological parameters and using the feedback provided by the virtual environment is able to gauge his or her success. The supplemental use of portable devices, such as PDA or smart-phones, allows the patient to perform at home, individually and autonomously, the same exercises experienced in therapist's office. The goal is to anchor the learned protocol in a real life context, so enhancing the patients' ability to deal with their symptoms. The expected result is a better and faster learning of relaxation techniques, and thus an increased effectiveness of the treatment if compared with traditional clinical protocols.

## Protocol

The clinical protocol for the treatment of the Generalized Anxiety Disorder (GAD) is programmed simultaneously *inside* and *outside* the therapist's office. Relaxation program is a combination of "Progressive Muscle Relaxation Training" (PMRT), the classic procedure described by Jacobsen, that involves tensing and relaxing various muscle groups while taking note of the contrasting sensations, and "Guided Imagery" program. In our training imagery is replaced by the visual cue of a relaxing virtual environment.

**INSIDE THE THERAPIST'S OFFICE.** Patients participate to 8 training sessions with the therapist, distributed in four weeks (2 sessions per week). Each session starts and stops with a clinical evaluation that gives the measure of the patient's anxiety.

Plan of sessions in the therapist's office:

1. Initial clinical evaluation of the patient's state;
2. The patient is connected with biosensors that record his/her physiological parameters (skin conductance, heart rates, respiration). A baseline measure of these parameters is registered for 3 minutes;
3. The patient wears an head-mounted display connected with a pc and handles a joystick;
4. The patient starts exploring the virtual environment: a beautiful tropical island facing on the ocean. The patient, following the narrative recorded by the therapist, reaches the island by boat and explore it. Following a footpath that guides him/her through the island, the patient arrives to the starting point, where different panels indicate the directions to the different target areas. In each of these areas a relaxing exercise is provided; during this training, following the indications given by the voice-guide, the patient tries to relax him/herself while some elements of the virtual environment are directly modified by his/her physiological parameters recorded in real time. Thus, the patient receives an immediate feedback of his/her level of activation (as in the traditional biofeedback techniques), but with the extra value given by the virtual environment that he/she is immersively exploring. The target areas are bound to:
  - Campfire: physiological parameters control the fire intensity, so that the reduction of the patient's physiological activation results on a reduction of the fire until it goes out;
  - Waves: physiological parameters control the waves until the ocean becomes completely calm;
  - Waterfall: the reduction of the physiological arousal corresponds to a reduction of the stream intensity until the water stops to fall down.
  - Gazebo: differently from the others, this exercise is customizable by the patient, who can choose words or images related to him/her personal stressful events. This technique serves as a stress inoculation program, and the patient can experience the reduction in size -fading-floating of the chosen item - depending on his/her ability to relax him/herself;
5. Once completed the virtual reality session, physiological parameters are recorded again in rest condition;
6. Final clinical evaluation of the patient's state.

**OUTSIDE THERAPIST'S OFFICE:** In order to improve the efficacy of the training and to increase the effects of relaxation, patients will practice relaxation techniques outside therapist's office by experiencing a Homecare Scenario. This is realized by presenting the same virtual environment experienced during the therapy on a mobile device. The mobile device is connected via Bluetooth to a set of biosensors that includes heart rates and skin conductance. This equipment is small enough and easy-to-use to be autonomously handled by the patient (see fig. 1). The patient is required to train relaxation abilities at least once a day for the entire duration of the treatment (one month), following the treatment plan provided by the therapist.

## Representative Results

Because both biofeedback and virtual reality are known to be effective to induce relaxation, the main expected result is that a combination of these two methods is more effective in reducing anxiety in patients affected by generalized anxiety disorder, than the two techniques individually used.



**Figure 1:** GSR/HR biosensors module.

## Discussion

Our hypothesis is that the combination of virtual reality and biofeedback that directly modifies the virtual environment, compared with virtual reality alone, will result in a better and faster relaxation learning. If so, this new instrument created to treat anxiety disorders could be applied and tested even in other anxiety-related pathologies.

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